

## CLAIMS

1. A method for on-line control of a butt-welding machine for bars, blooms or billets, during welding cycles, comprising the steps of

- controlling an actuation of a first actuator (U) for opening a valve controlling a

5 positioning of clamps of the welding machine; and

- controlling the triggering angle of a partializer for controlling the thermal power supplied to the welding process;

said controlling steps being regulated on the basis of an analysis by a dynamic state observer (A) of the history of the welding process during execution of each

10 welding cycle, for estimating the trend of a plurality of state variables (X) and of performance variables (Z) to be used as basis for the action of controlling the cycle itself and the subsequent welding cycles.

2. The method according to Claim 1, wherein for the regulation of said controlling steps there is provided:

15 - observing state variables (X) of the welding cycles by the dynamic state observer (A);

- defining pre-determined optimal paths ( $Z_{set}$ ) to be followed by a plurality of performance variables (Z) by means of a dynamic path generator (B) for performance variables (Z);

20 - executing a dynamic control law (C) based upon the value of the performance variables (Z), of the optimal paths ( $Z_{set}$ ) and of an operating strategy determined according to the step that the welding process is undergoing; and

- generating sync signals (Sync) by means of a signal generator (E), on the basis of which the dynamic control law (C) adopts the given operating strategies.

25 3. The method according to Claim 2, wherein the performance variables (Z) controlled by the dynamic control law (C) comprise: arc impedance, arc length and primary voltage of arc current.

4. The method according to Claim 3, wherein the dynamic control law (C), during a scintillation step of the welding process, maintains the arc length constant and 30 varies the primary voltage of arc current on the basis of the variation of arc impedance.

5. The method according to Claim 4, wherein an on-line diagnosis is provided by a dynamic diagnostics system (D), for which the comparison of the paths of the

performance variables ( $Z$ ) is made with the desired paths ( $Z_{set}$ ) by said dynamic diagnostics system (D), generating weld quality indices.

6. The method according to Claim 5, wherein there is provided automatic on-line variation of the transformation ratio of a transformer (tap changing) for supply of  
5 the butt-welding machine.

7. A system for controlling a butt-welding machine for bars, blooms or billets, for implementing the method according to Claim 1, wherein the machine comprises an actuator (U) for opening a valve for controlling positioning of clamps of the butt-welding machine, and a partializer, wherein the control system comprises:

10 - a dynamic state observer (A) adapted for observing a plurality of state variables ( $X$ ) of a welding process carried out by the machine;

- a dynamic path generator (B) for performance variables ( $Z$ ), adapted for defining pre-determined optimal paths ( $Z_{set}$ ) for the performance variables ( $Z$ ) to follow;

- a dynamic control law (C) adapted for controlling the actuator (U) and the  
15 partializer on the basis of the value of the performance variables ( $Z$ ) and of the optimal pre-determined paths ( $Z_{set}$ ); and

- a generator (E) of sync signals adapted for generating sync signals (Sync).

8. The system according to Claim 7, wherein there is provided a transformation ratio variator (tap changer), adapted for controlling the transformation ratio.

20 9. The system according to Claim 8, wherein a dynamic diagnostics system (D) is provided, adapted for generating indices of weld quality, comparing the paths of the performance variables ( $Z$ ) with the desired paths ( $Z_{set}$ ).

10. The system according to Claim 9, wherein the observer (A) of dynamic state, the dynamic path generator (B), the dynamic control law (C), the generator of sync  
25 signals (E), and the dynamic diagnostics system (D) are implemented by means of a computer program.

11. The system for controlling a butt-welding machine for bars, blooms, or billets according to Claim 10, wherein the machine is of the flash-welding type.